Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/450
HUNGARY
February 1964
Submitted in:
ENGLISH and RUSSIAN

Confidential until official release during Conference

Abstract

INVESTIGATIONS CONCERNING THE PROCESSING OF HUNGARIAN URANIUM ORES

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Results achieved these last five years by research activities on problems in the processing of uranium ores are reported.

I. Mineralization and Deposition Studies

The mineralization of uranium is a rather frequent process in the sediments of continental rivers and the facies conditions of this type of depositions have been investigated in detail. It is found that the water getting into the loose sediments along the river banks with floods and in the form of underground water can be made first of all responsible for the primary enrichment in uranium. Dia- and epigenetic variations play an important part in the formation of the mineral grains. These results can be utilized in establishing the genesis of other deposits too.

II. Weight Correction Radiometers and Optimum Grain Size for Radiometric Recovery Procedures

The physical principles involved in the methods for weight correction based on photo effect and induction

are discussed and the radiometers incorporating these principles are described. The procedure so developed permits to reduce the number of grain size fractions processed by radiometry and improves the recovery efficiency.

Experimental investigations of blasting and processing techniques in view of obtaining the optimum grain size for radiometric sorting are described. The application of the laboratory results on a production scale is illustrated.

III. Reduction of Loss due to Leaching for Uranium Ores with Carbonate Content

In sulfuric acid leaching of uranium ores containing also carbonates calcium sulphate is coprecipitated with uranium from the liquid phase. This loss in uranium recovery can be prevented by reducing first the carbonate content of the ore in a flotation process. The product which upon flotation contains the carbonate can be efficiently processed by alkaline leaching. The product containing less carbonate is then processed by sulfuric acid leaching. The two kinds of leaching considerably increase the amount recovered as compared with the merely sulfuric acid leaching of such ores. The cost of chemicals is also reduced. In the carbonate separation process it was found that the loss in U due to adsorption is caused by the decomposition of the carbonate complex.

IV. Extraction from Elutes

Some extractants or such mixtures which seemed promising for the purification of solutions eluated from ion exchange resins have been investigated. The extraction isotherms and the effects of ions in the liquid phase /sulphate, chloride, hydrochloric acid etc./ on the extraction rate were determined. The optimum conditions for the extraction were established. A possible reextraction from the organic phase was studied.

In laboratory experiments the mixtures di-2-ethylhexyl phosphate and tri-butyl phosphate as well as di-capryl phosphate and tri-capryl phosphate were found to be satisfactory extractants. For reextraction ammonium carbonate solution proved to be the most convenient.

Considering the problem of mixed solvents the synergetic and antagonistic effects manifesting themselves in organic solvent extraction are discussed. In these experiments di-alkyl and tri-alkyl phosphates as well as beta diketone and di-alkyl phosphate mixtures were used. The structures and some physico-chemical properties of these uranium-organic complexes were determined.

V. Structural Investigations of Ammonium Uranates and Uranium Oxide Hydrates

A several step gravitation type mixer-settler equipment has been built for the purpose of laboratory extraction.

This device is used for the production of reactor grade uranium compounds from inland uranium concentrates by means of the usual TBP treatment.

Laboratory investigations were carried out to establish how the composition and physical properties of the products are being affected by the conditions under which the precipitations and calcinations of ammonium uranates occur.

Basic investigations concerning the structure and thermal decomposition of ammonium uranates and uranium/VI/ oxyhydrates were carried out. Formation, composition and thermochemical properties of the $UO_2/NO_3/_2$-NH_3, UO_3-H_2O and UO_3-H_2O-NH_3 systems were studied. New relationships between the structures and thermal decomposition of uranium tri-oxide hydrates and ammonium uranates were established from infrared and differential thermoanalytical investigations.